Task 15: Human Factors Guidance for Head-Up Display (HUD) Equipment Design and Operation (Williams)

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Project Start Date: 9/01/2009 **Anticipated End Date:** 9/30/2010

Requirements Statement
Operational Shortfall or Knowledge Gap Human factors research is needed to provide requirements and guidelines to facilitate FAA Aircraft Certification Engineers, Test Pilots, and Human Factors Specialists in their evaluations and approvals of HUDs.
Benefit in Closing the Shortfall or Gap The research will feed the development of an Advisory Circular on HUD design that will ease the task of granting approvals for their use in general aviation aircraft and rotorcraft.
Description of the Desired Product A literature review of HUD-related human factors research and an industry review of current and expected HUD products would be two key products
Schedule This research is intended to be a multi-year project, continuing until AC 25-11 is published, and may continue beyond that point if(when) AIR-130 decides to pursue a 20 series AC.

Research Objective
Establish the current state of HUD design and operational knowledge from research literature, performance standards (e.g., RTCA, SAE, and FAA documents), documented operational uses of HUDs, previous designs and certification efforts, current fielded systems, and current design efforts. Analyze the symbology and information displayed on the HUD, alerting, roles and responsibilities/accountabilities of flight crew (single vs. dual HUD), prioritization of information (HUD vs. head's down displays), continuous vs. part-time information display, flight deck integration, workload, procedures and workflow, and training requirements.

Background
HUDs have been in use in military aircraft for a number of years and, more recently, in some commercial-carrier aircraft. Recently we have had requests to approve the use of HUDs for other types of operations (Part 23 and Part 27 aircraft). Additionally, new HUD technology, features, and functions are constantly being developed. The FAA has no official published Advisory Circular to facilitate the evaluations, which would streamline the HUD approval process. The approvals have all been based on issue papers and the SAE guidance that has been published. Research needs to be done to identify the human factors issues with the current HUD technology.

Previous Activity on this Task

AC 25-11 is the Electronic Displays Advisory Circular for Transport Category Airplanes. This document is currently being revised by the Avionics Harmonization Working Group (also known as the Avionics ARAC). The current version of the AC is available on the FAA's website under the "Regulatory and Guidance Library" The Avionics Group (AIR-130) in the FAA is considering developing a cross-regulation (20 series) Advisory Circular for HUDs, but is waiting for some of the issues to be ironed out in the Part 25 series AC first (Joint Advisory Circular, AC 25.1329 – 1X, draft).

Proposed or Planned Research

A literature review and an industry review of current and expected HUD products would be two key products. This may be done in one document or in two separate documents. The document/report(s) should include a summary of current HUD state of knowledge; recommended requirements and guidance to be included in the FAA Advisory Circular; current HUD systems (avionics inventory); current HUD operations; current HUD approvals, and an issues list of areas of concern. Specific topics reported should include: key safety-related design issues and tradeoffs; shortcomings of current guidance; solutions and recommended future work: suggested requirements and guidance for the design, evaluation, and approval of HUDs.

Research Question(s)

- What is the current state of the art in HUD design and implementation?
- What are the critical human factors issues related to current HUD designs?
- How are HUDs currently being used in the NAS?
- Where is the industry heading in regard to new HUD designs and implementations?

Technical Approach

Current Year

Phase One of the research will establish the current state of HUD design and operational knowledge from research literature, performance standards (e.g., RTCA, SAE, and FAA documents), documented operational uses of HUDs, previous designs and certification efforts, current fielded systems, and current design efforts. This effort includes both literature reviews and informal discussions with both HUD manufacturers and pilots. Background research should include lessons learned from previous HUD approvals. Phase One research will also involve the generation of a HUD industry review/inventory of what products are currently on the market, in which specifications for all manufactured designs are identified and collected for analysis. Hands-on evaluation by human factors specialists is encouraged when developing this inventory.

Out-Years

Phase Two of the research will focus on analysis. At the human-machine interface level, the human factors issues that need to be studied include: symbology and information displayed on the HUD, alerting, roles and responsibilities/accountabilities of flight crew (single vs. dual HUD), prioritization of information (HUD vs. head-down displays), continuous vs. part-time information display, flight-deck integration, workload, procedures and workflow, and training.

Air Traffic Resources Required

None

Information Technology Resources Required

None

Calibration
None

FY10 Milestone Schedule		
Description	Proposed Start Date	Proposed Completion Date
Solicit contract to assist with the human factors research related to HUD design.	FY09 Q4	FY09 Q4
Conduct literature review of human factors research related to HUD design and implementation	FY10 Q1	FY10 Q2
Conduct informal discussions with HUD manufacturers and pilots to assess previous design and certification efforts, current systems, and projected future systems	FY10 Q1	FY10 Q3
Generate a HUD industry review/inventory, including hands-on evaluations by human factors specialists	FY10 Q3	FY10 Q4

FY10 Deliverables		
Description	Proposed completion date	Actual completion date
Literature and industry review of current and projected HUD products	FY10 Q4	